The Egg Capsules of *Jenneria pustulata* (LIGHTFOOT, 1786) with Notes on Spawning in the Laboratory

BY

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(1 Text figure; 1 Table)

INTRODUCTION

Jenneria pustulata (LIGHTFOOT, 1786) is a brightly colored cypraeacean distributed in shallow water from the southern end of the Gulf of California to Ecuador (KEEN, 1958). It is a hardy species normally found in association with the stony corals upon which it feeds. The relationship of the species to other members of the superfamily is not well established. KEEN (*op. cit.*) believes the shape of the radular teeth and other anatomical characters can be homologized with those of *Trivia*; however, SCHILDER (1936) places *J. pustulata* in the Ovulidae (Amphiperatidae). Data on the structure of the egg capsule and the larval stages can add to the understanding of phylogeny in this species.

METHODS

Adult specimens of *Jenneria pustulata* were collected by Dr. F. M. Bayer of the Institute of Marine Sciences, University of Miami, from Venado Island in the Bay of Panama in August, 1965. Of this material, a pair (female 18 mm, male 13 mm) were transported alive to the Institute, where they were maintained for three years. The specimens were kept in an aquarium with running sea water at ambient temperatures. Assorted coelenterates were also kept in the same aquarium. Stony corals, including *Porites* sp., *Phyllangia americana* MILNE-EDWARDS & HAINE, 1850 and *Siderastrea siderea* ELLIS & SOLANDER, 1786 were used as food. There was a marked preference for *Phyllangia* over the the other species; however, all were eventually accepted. During the period of observation, which extended from January, 1967 to May, 1968, the animals were not disturbed and had a constant supply of food.

The egg capsules and embryos were preserved in 10% sea water formalin. All drawings were made from preserved material with the aid of a camera lucida.

BREEDING HABITS

Spawning began when the water temperature exceeded 24° C for 3 to 4 weeks (Table 1). The breeding season at Miami extended from April to December. During this period, 20 egg masses were produced. The number of capsules deposited per spawning ranged from 14 to 233 with an average of 125. A total of 2495 capsules was produced. Copulation took place from about 4 days to minutes prior to the beginning of spawning. The female moved onto the walls of the aquarium away from the sediment before beginning to spawn. No capsules were found on the corals. During the annual period, this process was repeated approximately twice a month.

Before selecting a site for oviposition, the female examines the walls of the aquarium for several hours. After selection, an area slightly larger than the diameter of a capsule is cleaned of periphyton and other surface deposits by the radula for about 8 minutes. Then the propodium is folded over the cleared area, and a capsule is passed from the oviduct down a ciliated groove on the right side. Transport involves about one minute. The propodial muscles knead the capsule while it is held in place. Glandular cells secrete a layer of adhesive which imparts the final shape. Cleaning begins again about 2 minutes before the capsule is completely attached. The whole cycle involves approximately 20 minutes. At this rate to produce the larger egg masses, oviposition must continue for at least 3 days. Brooding, as noted among related cypraeaceans by OSTERGAARD (1950), does not occur.

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Table 1

The Spawning of *Jenneria pustulata* at Miami, Florida

Date	Number of Capsules per Mass	Bay Temperature (° C)
January, 1967	0	21.5 [1]
February	0	21.5 [1]
March	0	22.0 [1]
April	–	25.0 [1]
April 26	120	26.5
April 30	14	25.0
May 21	145	28.0
May 31	101	28.5
June 19	72	28.0
June 26	85	30.0
July 4	50 [2]	29.5
July 7	81 [2]	29.0
July 20	99 [3]	30.0
July 22	64 [3]	30.0
July 28	79	30.5
August 7	192	29.0
September 3	169	30.0
September 18	111	29.5
September 25	110	29.0
October 22	205	25.5
October 27	211	26.5
November 9	233	25.0
November 20	202	24.0
December 5	152	23.0
January 1968	0	21.5 [1]
February	0	20.0 [1]
March	0	21.5 [1]
April	–	24.5 [1]
April	179	26.0

[1] = average; [2] = communal mass; [3] = communal mass

There is some indication that communal spawning takes place in the natural habitat. In two instances, the parent returned to an egg mass several days after the initial spawning to deposit capsules (Table 1). In areas with dense populations, it is possible that several females will use the same mass. Communal structures can be identified during development by noting that the contents of the older oothecae have a uniformly darker pigment.

The EGG MASS

Each cluster of oothecae forms a very irregular oval with a long dimension varying between 5 mm and 30 mm. The pustulate capsules are always placed in a single layer. When overlapping between adjacent structures occurs, only a small portion of the edge of each is involved (Figures 1 a, 1 b). The escape aperture is never covered. Placement of the oothecae in the mass does not vary. The side with the aperture is always placed between 2 capsules in a preceding row. The arrangement of the capsules in long arcs reflects the movements of the parent during spawning.

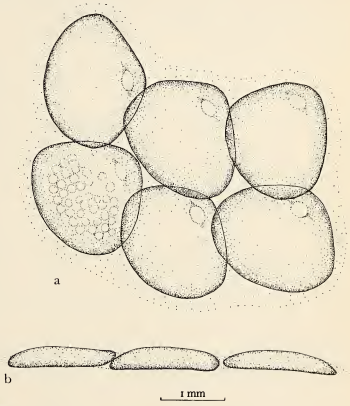

Figure 1

The Egg Capsules of *Jenneria pustulata*

a: dorsal view of 6 capsules from a typical egg mass. One capsule contains embryos.
b: lateral view of 3 capsules.

Oothecae of *Jenneria pustulata* are transparent, colorless, pustulate structures which are somewhat variable in shape. The basal outline of each capsule is roughly the shape of an obtuse triangle with rounded angles (Figure 1 a). Occasional capsules, ovate or round in outline, are the result of the parent's ability to mold the capsules into a compact mass. An oval suture in the membranes of the upper surface close to the obtuse angle marks the escape aperture. Indistinct sutures extending laterally from the aperture reflect the bilobed structure of the oviduct (Fretter & Graham, 1962). The average dimensions of the capsules are: length – 2.3 mm; width – 1.7 mm; and height – 0.5 mm. Individual oothecae

contain from 65 to 107 embryos and average about 90. The number of embryos per mass varied between 1 200 and 21 000 with an average of 11 200. The total seasonal production for the female was 224 500 embryos.

Development is indirect, with the formation of a long-term planktotrophic veliger. The pinkish-brown pigment which appears in the capsules after about 4 days is the result of the development of a pigmented protoconch. Hatching begins after 13 or 14 days and is completed in 24 to 72 hours.

DISCUSSION

The egg masses of cypraeaceans have general characters which are very uniform within a given genus; however, in some families (as presented by KEEN, 1958) considerable variation does occur. These variations are reconciled in part by suggestions to separate the groups with an echinospira larva (see FRETTER & GRAHAM, 1962). A number of cypraeids were examined by LO BIANCO (1899), VAYSSIÈRE (1927), and OSTERGAARD (1950). A survey of these investigations and personal observations on the spawn of *Cypraea spurca acicularis* GMELIN, 1791, *C. cervus* LINNAEUS, 1771, and *C. zebra* LINNAEUS, 1758, have shown that the structure of the egg capsules in this family is very uniform. As noted by OSTERGAARD (*op. cit.*), brood protection is also a characteristic of the family. *Erronea errones* (LINNAEUS, 1758) (NATARAJAN, 1958) has a layered egg cluster quite similar to that of *Cypraea* and also exhibits brood protection. The capsules of *Trivia arctica* (MONTAGU, 1803) and *T. monacha* (DA COSTA, 1778), which were studied by LEBOUR (1932 a), differ greatly from those of their suggested close relative, *Jenneria pustulata,* in that they are vasiform and are imbedded individually in compound ascidians. Both species have a characteristic echinospira which does not occur in *J. pustulata.* In the Ovulidae, however, *Simnia patula* (PENNANT, 1777) (LEBOUR, 1932 b) has pustulate capsules arranged in a single layer like *J. pustulata.* Similar structure and placement is also found in another ovulid, *Cyphoma gibbosum* (LINNAEUS, 1758) (personal observation).

In conclusion, it can be stated that the structural arrangement and placement of capsules by *Jenneria pustulata* is most similar to the processes occurring in the Ovulidae and that a close relationship is implied.

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